

## **The Decline of Herring at Cherry Point, Washington**

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The stock of herring (*Clupea pallasii*) which spawns in the vicinity of Cherry Point (near Bellingham) once was the largest stock of herring in Washington. The stock has shown a dramatic decline of 95 percent in recent years and is now at an unprecedented low level of abundance. There are several potential explanations for the decline including increased mortality of adult herring, decreased hatching success, changes in the offshore environment and degraded spawning habitat.

Results from recent studies by the University of Washington indicate the herring eggs deposited near Cherry Point have low hatching success and high rates of abnormal development. Those larvae that do hatch successfully are very small compared to larvae from other areas.

The spawning habitat at Cherry Point is also the site of major industrial activity. Several industries use the spawning area, and there are plans to expand the existing facilities and add new facilities in the near future. There is a growing need to ensure that the industrial activities are not contributing to the decline of herring in the area. To address the issue, representatives from several state agencies (Fish and Wildlife, Ecology and Natural Resources) and affected industries have been meeting regularly to design studies and evaluate the results.

Next year will be important for the future of the herring stock. Another year of poor adult returns will drive the stock to the brink of extinction. The Department of Natural Resources will decide on issuing leases for expanded industrial activity at Cherry Point.

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## **An Integrated Molecular Biomarker System to Assess and Compare the Health of Aquatic Life in Washington State Waters**

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We are conducting field and laboratory studies to validate the utility of cellular biomarkers in assessing coastal ecosystem health. Several species of marine invertebrates are being collected along a gradient of anthropogenic inputs extending from the pristine outer coast of Washington, through the Strait of Juan de Fuca and into Puget Sound. Within Puget Sound, samples are being collected from both commercial areas and fish habitats with known or suspected gradient of anthropogenic insult. Cellular biomarkers, tissue residues and environmental stressors will be assessed to determine if they are predictive of the gradient in stressors and predictive of one another.

Biomarker analysis will be conducted using the *Downs Molecular Biomarker System*<sup>™</sup> (MBS). MBS uses an integrated suite of 10-15 molecular biomarkers to detect physiological changes at a subcellular level to assess an organism's health. The biomarkers include general indicators of cell integrity (e.g., GSH, LPO and ubiquitin), molecular chaperones that gauge the integrity of enzyme pathways (Hsp 60 & 70), small heat shock proteins produced in response to heat stress and other insults ( $\alpha$ B-crystallin, Hsp22, Hsp26 and Hsp30), anti-oxidant enzymes indicative of oxidative stress (MnSOD and Cu/ZnSOD), and indicators of xenobiotic exposure (cytochrome P450) and metal stress (metallothionein).

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## Summary of Major Findings from the U.S. Geological Survey National Water-Quality Assessment Program in the Puget Sound Basin

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Small streams and large rivers in the Puget Sound Basin met most Federal and State water-quality guidelines, but there were exceptions. The insecticide diazinon, commonly used by homeowners on lawns and gardens, was frequently detected in urban streams at concentrations that exceeded guidelines for protecting aquatic life, and levels of *E. coli* bacteria were above USEPA criteria for moderate water-contact recreation in 15 of 31 small streams. Concentrations of total phosphorus were above the USEPA desired goal of 0.1 milligram per liter to prevent excessive plant growth in large rivers and small streams in agricultural and urban areas, but not in undeveloped areas. Streams in urban and agricultural areas were also warmer and supported less diverse populations of insects than streams in forested areas.

With some exceptions, ground water was of high quality. However, as indicated by elevated concentrations of nitrate and the presence of pesticides and other organic compounds, shallow ground water in both urban and agricultural settings is vulnerable to contamination. Deeper ground water is less affected by land-use activities. For example, pesticides were not detected in wells deeper than 120 feet, the depth below which most large public supply wells withdraw water.

## Patterns of Amphibian Use of Stormwater Ponds in King County

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Stormwater ponds are built to protect human health and safety as well as aquatic resources, primarily including wetlands and streams. Stormwater ponds are generally designed to detain stormwater and improve water quality, and may have unintended impacts on wildlife. A two-year study of 50 stormwater ponds in King County is being undertaken to determine the extent of use by amphibian species, whether mortality occurred prior to larvae metamorphosis due to pond drying, and if landscape and in-pond factors correlate with amphibian use. Pond age ranges from 1 to approximately 16 years. Preliminary results indicate that three species of caudates (Northwestern salamander—*Ambystoma gracile*, long-toed salamander—*A. macrodactylum*, rough-skinned newt—*Taricha granulosa*) and three species of anurans (red-legged frog—*Rana aurora*, bullfrog—*R. catesbeiana*, Pacific treefrog—*Hyla regilla*) breed in stormwater ponds. All ponds with standing water greater than 15 cm deep in March-April supported breeding amphibians. All species can colonize within two years of pond construction, and Pacific treefrogs colonized ponds in less than six months. Bullfrogs do not appear to exclude native amphibian species, and are occasionally present in temporarily flooded ponds. Northwestern salamander paedomorphs were observed in approximately 25 percent of ponds. Pacific treefrogs occurred most frequently, and rough-skinned newts were the least common of the six species observed. The Oregon spotted frog (*Rana pretiosa*) and Western toad (*Bufo boreas*) were not observed. Species richness appears to be positively correlated with the presence of forest within 100 meters of stormwater ponds. Fewer than five percent of ponds were observed to dry before larvae metamorphosis. Future work will examine the extent of egg stranding and correlations between water level fluctuations and species occurrence.